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Navy—OPPO 1ND, Portsmouth, N. H.

**HIGH IMPACT SHOCK TESTS ON TOGGLE
SWITCHES - REED SWITCH COLORA-
TION, EXHIBITOR - NSMB67-017**

Evaluation Report No. " ETL-2004

10 October 1988

APPROVAL INFORMATION

Submitted by

**K. SHIMA
Electrical Engineer**

Approved by

**A. W. CROCKER
Electrical Engineer**

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

BUSHIPS Itr	<u>562/2-1(665J); cov 665-3141</u>
Date:	<u>26 Jul 1956</u>
Index No.	<u>NSN667-017</u>
STL Report	<u>2994</u>

Report of Tests

on

Toggle switches

submitted by

Micro Switch Corporation, Freeport, Illinois

Ref: (a) BUSHIPS Itr 562/2-1(665J); cov 665-3141 of 31 Jul 1956
(b) BUSHIPS Itr 562/2-1(565J); cov 565-2114 of 26 Jun 1957
(c) BUSHIPS Itr 562/2-1(565J); cov 565-4387 of 18 Nov 1957
(d) Specification MIL-S-901B of 19 Dec 1955
(e) FTSC NAVSHIPS Itr 360; SS/562/2-1(20813) of 28 Aug 1957,
forwarded ⁱⁿ Report No. 2726 to BUSHIPS (Code 312)

Incl: (1) Photograph showing six types of toggle switches as received for tests - Negative No. 3133
(2) Photograph showing five types of toggle switches as received for tests - Negative No. 3134
(3) Photograph showing six types of toggle switches as received for tests - Negative No. 3135
(4) Photograph showing three types of toggle switches as received for tests - Negative No. 3136
(5) Oscillogram showing contact opening or transfer during high impact shock test
(6) Photograph showing typical failures encountered during high impact shock test - Negative No. 3174
(7) Tabulated results of high impact shock tests

1. Antiquity - reference (a)

Priority -	regular
Index No. -	NSN667-017
Cost classification -	Allotment J2291/sPN59.23

enclosure (1)

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

Subj: Test 3996; Toggle switches; N31037-017

Date samples received - 13 August 1958
Date tests started - 22 September 1958
Date tests completed - 30 September 1958

2. Purpose - The purpose of this investigation was to ascertain which of the standard toggle switches would withstand the high impact shock requirements of reference (d).

3. Description of Material - The material received for tests comprised two each of the following switches, manufactured by Micro Switch Corporation:

Manufacturer-

Curer's Type	All Type	N3 Type	JAN Type
117S1-1	3021-1	35059-21	5140B
117D1-3	3021-3	35059-23	5140D
117D1-21	3021-10	35059-24	-
317S1-3	3022-3	35103-23	5145D
327D1-1	3023-1	35103-21	T353P
327S1-3	3023-3	35103-23	T493N
327G1-21	3023-11	35103-24	-
127G1-1	3027-1	35059-21	5150P
127S1-3	3027-3	35059-23	5150N
127S1-21	3027-9	35059-24	-
337S1-1	3226-1	35103-21	-
337D1-3	3226-3	35103-23	-
337S1-21	3226-4	35103-24	-
12L1-1			
12L1-3			
12L1-21			
27L1-1			
27L1-3			
27L1-21			
317S1-21			

Photographs, enclosures (1) thru (4), illustrate one sample of each of the twenty types of switches received for tests.

4. Method of Testing - The switch samples were mounted on a steel plate, as shown on figure 69 of reference (d), and were subjected to impacts of 400, 1200 and 2000 foot-pounds, applied on each face the back, top and side of the equipment. Test on any sample was dis-

(1)

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

Subj: Test 2994; Toggle switches; USN087-017

continued if failure occurred. For the types of switches with a locking "On" position, one sample was checked in the "On" position, and the other sample was tested in the "Off" position. After each blow, circuit continuity was checked. A brush recorder was connected in the circuit to register contact opening or transfer during each impact on each switch.

5. Results of Tests - The results of tests are tabulated on enclosure (7). These results may be summarized briefly, as follows:

- a. Of the one sample of each type of switch tested in the normally closed position, an indication of contact bounce and/or switch opening was noted on each type as a result of some one or more of the nine impacts delivered to each sample.
- b. Of the one sample of each type of switch tested in the normally open position, only seven types, namely, 28L1-3, 28L1-21, 11T81-1, 32T81-1, 33T81-1, 33T81-3 and 33T81-21, mal-functioned. The mal-functioning included fractures, stripping of the abuse threads, loss of circuit continuity and inability to operate the switches manually.

Oscillograms were taken of each impact, but to eliminate including 180 such oscillograms in the report, only typical shots are included, covering at least one impact on each type of switch. The remaining oscillograms are on file in the laboratory and will be forwarded on request. Photograph, enclosure (6), indicates typical failures occurring on the switch samples.

6. Conclusions - Based on the results of tests on sample toggle switches, it may be concluded that

- a. each type of the 20 types of toggle switches, when tested in the normally closed position, would not be satisfactory for use in vital circuits because of momentary contact bounce during high impact shock test.
- b. toggle switches, types 28L1-3, 28L1-21, 11T81-1, 32T81-1, 33T81-1, 33T81-3 and 33T81-21, were unsatisfactory because of structural and/or mechanical failures.

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

subj: Test 2924; Toggle switches; NSN607-017

7. Discussion - Letter, reference (a), forwarded two samples each of 20 types of toggle switches, manufactured by Micro Switch Corporation, for shock resistance evaluation. References (b) and (c) authorized tests on only three and four pole switches, under the premise that if these passed, the single and double pole switches would be adjudged shock resistant. However, because of the failures reported by reference (a), the Bureau requested evaluation of the manufacturer's one and two pole switches.

The switches, as received, contained two samples each of the twenty types listed under "Description of Material". Consequently, one sample of each type was connected in a circuit to provide any indication of contact bounce of the normally closed contacts during high impact shock, while the duplicate sample was connected to indicate any momentary closing or transfer of the normally open contacts. Oscillograms were recorded of each impact on each switch sample. The records have been retained in the laboratory for record purposes, since no advantage would be gained by including in the report the 150-odd oscillograms. Typical records showing at least one impact on each of the twenty types of switches have been included as enclosure (3). These oscillograms indicate contact bounce on one or more impacts on all samples tested with the contacts normally closed, as well as operation of the switch from the normally closed to the open position. Thirteen of the twenty types of switches tested in the open position did not indicate any damage or contact bounce. The seven remaining types mal-functioned.

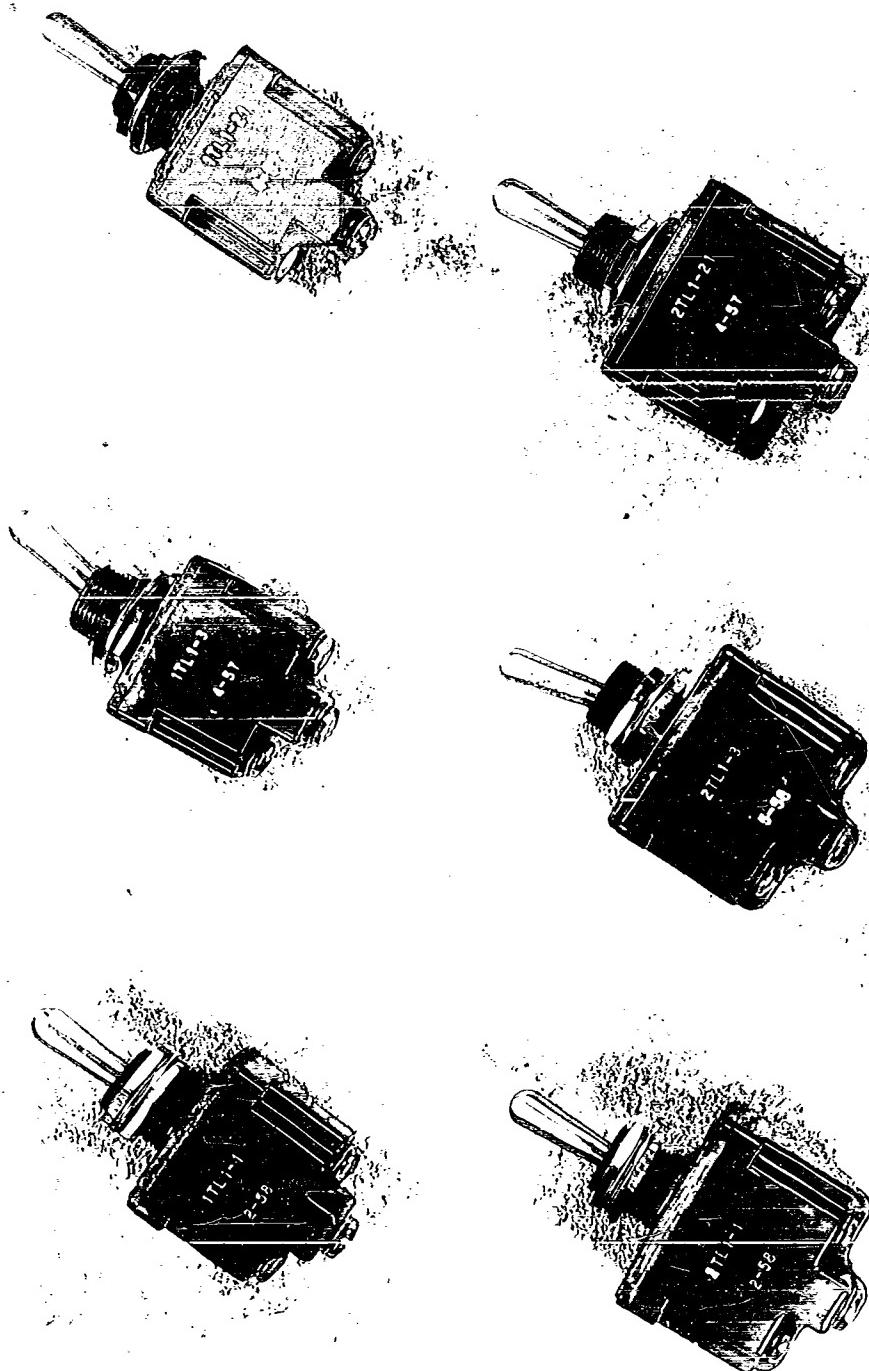
8. Recommendations - On the basis of tests, as conducted, it is recommended that

- a. none of the twenty types of toggle switches be considered suitable for use in vital shipboard circuits because of momentary contact bounce and/or switch transfer from "on" to "off".
- b. the types 274-1-3, 224-1-21, 41781-1, 32781-1, 33781-1, 33781-3 and 33781-21 switches be considered unsatisfactory because of fracture of and mechanical or electrical mal-functioning.
- c. Request - Two each of twenty types of toggle switches, manufactured by Micro Switch Corporation, and submitted as enclosure (1) of reference (a), were received for shock resistance evaluation.

ELECTRICAL TESTING LABORATORY
PORTSMOUTH, N. H.

Subj: Test 2994; Toggle switches; NSM67-017

Samples were subjected to high impact shock in accordance with reference (d), with oscillogram recordings taken of each impact. Results indicated seven types to be unsatisfactory because of fractured housings or other mal-functioning. The remaining types indicated contact bounce and/or switch operation from "on" to "off" as a result of impact and were recommended as unsatisfactory for use in vital circuits. Switches are being returned to the Bureau of Ships as enclosure (8) of letter forwarding this report for examination and disposition.



VIEW OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

ASC-9-5-58 - 3153

ITL1-1 ITL1-2
ITL1-3 ZTL1-2
ZTL1-1 ZTL1-3

TEST NO. 2994

NSM687-017

ENCLOSURE (1)

EX-20000103

VIEW OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

TEST NO. 2924

DATE 07-07-07

31TS1-3

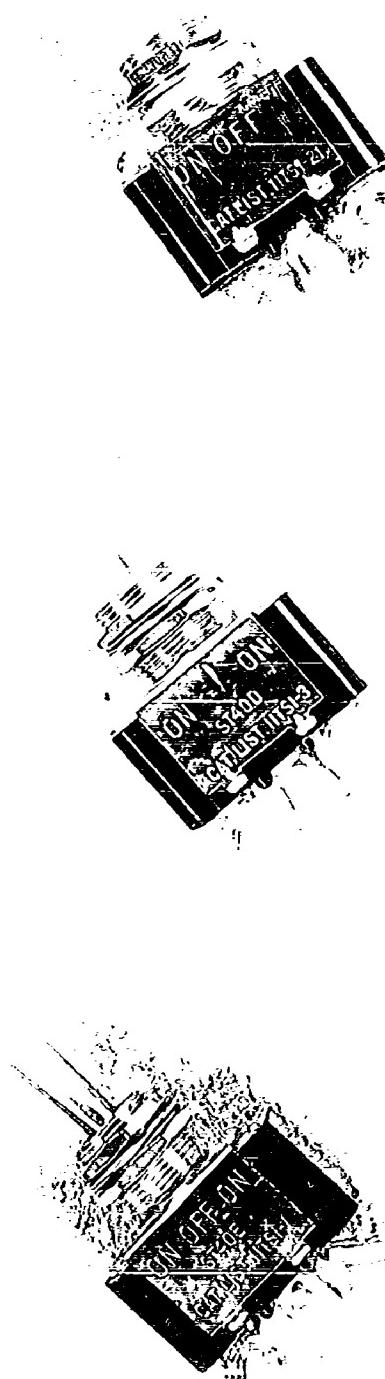
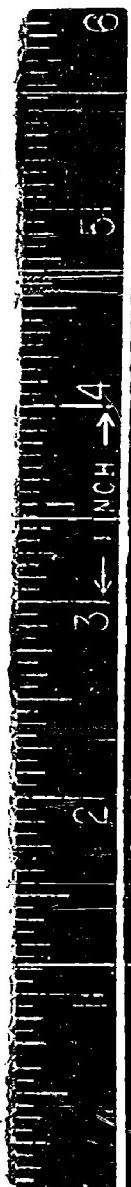
11TS1-3

11TS1-1

31TS1-21

11TS1-21

ASC-9-5-58 - 31X



ENCLOSURE (3)

VIEW OF NICO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION

L2TS1-21
37TS1-21

L2TS1-3
37TS1-3

TEST NO. 294

NSMC 87-017

ASC-9-5-58 - 3155

21

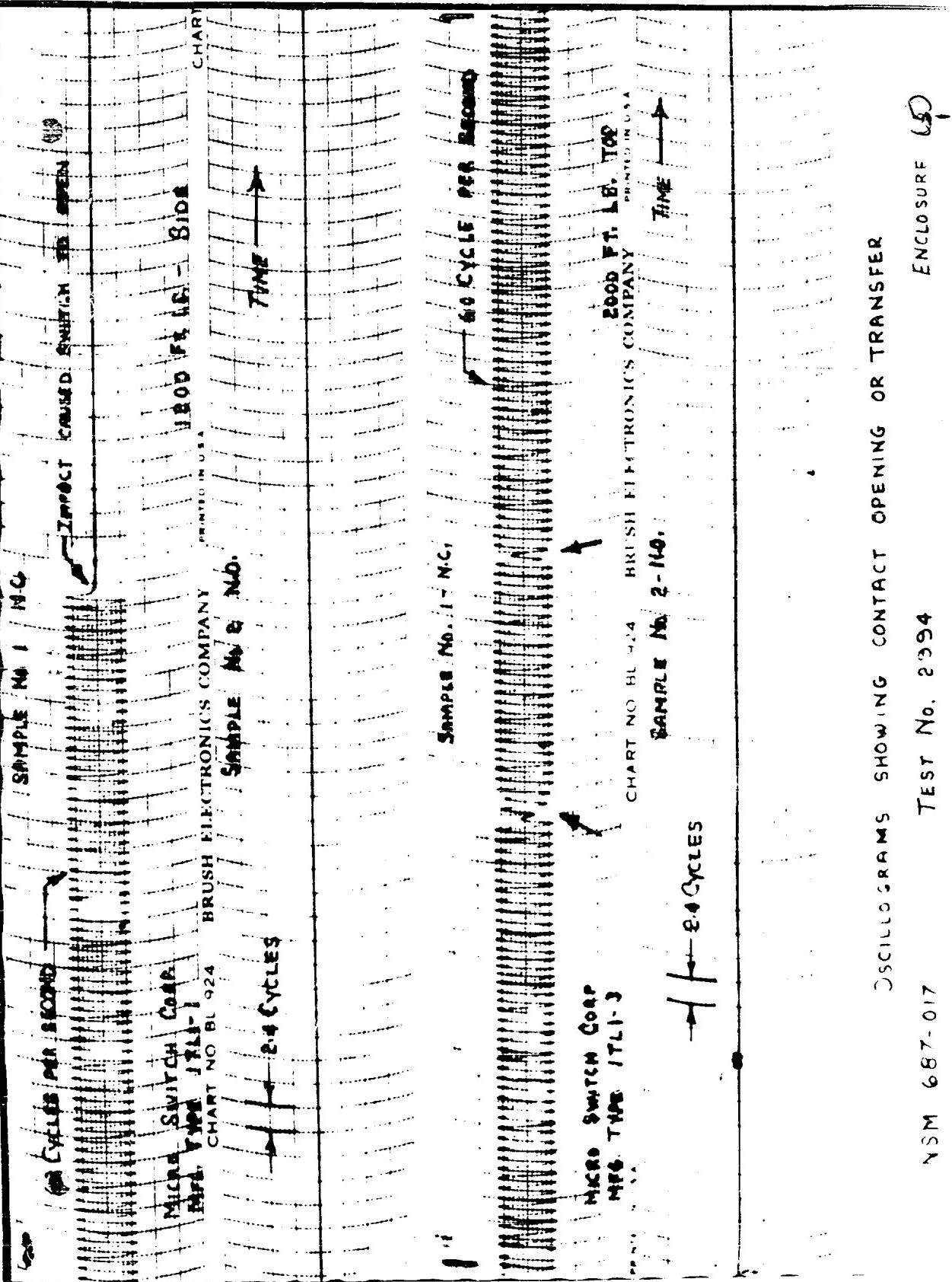
7 → 10 14 → 4



VIEWS OF MICRO SWITCH CORPORATION TOGGLE SWITCHES AS RECEIVED FOR SHOCK RESISTANCE EVALUATION
TEST NO. 2994
33TS1-1
33TS1-3
33TS1-21
NOMS 87-017

SC-9-5-58 - 3156
TEST NO. 2994
33TS1-1
33TS1-3
33TS1-21

ENCLOSURE (4)



Oscillograms showing contact opening or transfer

TEST No. 2394

NSM 687-017

ENCLOSURE 65

SAMPLE NO. 1 - N.C.

100 CYCLES PER SECOND

MICRO SWITCH CO.
MFG. TYPE ITL-21

CHART NO BL 924

BRUSH ELECTRONICS COMPANY

2.4 CYCLES

TIME →

IMPACT CAUSED SWITCH TO OPEN

SAMPLE NO. 1, N.C.

60 CYCLES PER SECOND

MICRO SWITCH CO.
MFG. TYPE ITL-21

CHART NO BL 924

BRUSH ELECTRONICS COMPANY

2.4 CYCLES

TIME →

IMPACT CAUSED SWITCH TO OPEN

SAMPLE NO. 2, N.O.

60 CYCLES PER SECOND

BOTH SAMPLES BECAME DISASSEMBLED DURING IMPACT.

OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

TEST NO. 2994
NSM 687-017

ENCLOSURE (5)
SHEET 2

SAMPLE No. 1 N.C.

60 CYCLES PER SEC NO

MICRO SWITCH CORP.
MFG. TYPE 2TLI-1

CHART NO BL 924 400 FT. L. - Top
BRUSH ELECTRONICS COMPANY

SAMPLE No. 2 N.O.

24 CYCLES

TIME →

SAMPLE No. 1 N.O.

60 CYCLES PER SECOND

MICRO SWITCH CORP.
MFG. TYPE 2TLI-3
CHART NO BL 924 BRUSH ELECTRONICS COMPANY

SAMPLE No. 2 N.O.

24 CYCLES

TIME →

Oscillograms showing contact opening or transfer

NSM 687-017 TEST No. 2994

ENCLOSURE (5)
SHEET 3

SAMPLE No. 1 INC.

1 CYCLES PER SECOND



Micro Switch Corp.
MP6, TYPE ITT-1
BRUSH ELECTRONICS COMPANY

PRINTED IN U.S.A.

← 2.4 CYCLES

TIME →

400 FT/LB. SENS.

CHART NO. BL 924

BRUSH ELECTRONICS COMPANY

SAMPLE No. 2 INC.

1 CYCLES PER SECOND

TIME →

SAMPLE No. 1 INC.

1 CYCLES PER SECOND



Micro Switch Corp.
MP6, TYPE ITT-1

PRINTED IN U.S.A.

SAMPLE No. 2 INC.

1 CYCLES PER SECOND

TIME →

400 FT/LB. SENS.

CHART NO. BL 924

BRUSH ELECTRONICS COMPANY

← 2.4 CYCLES

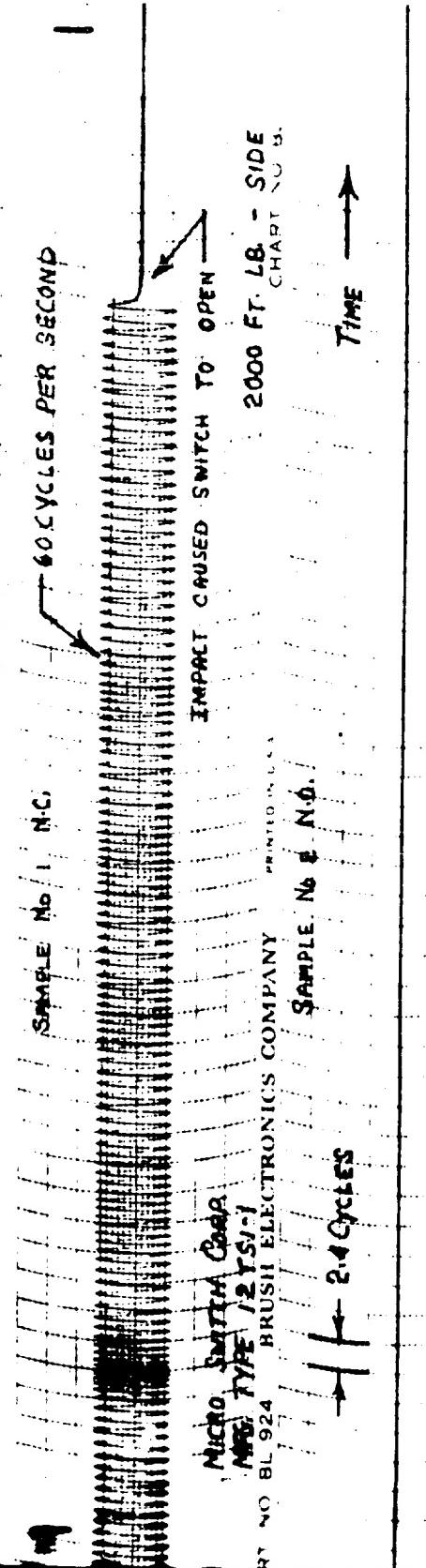
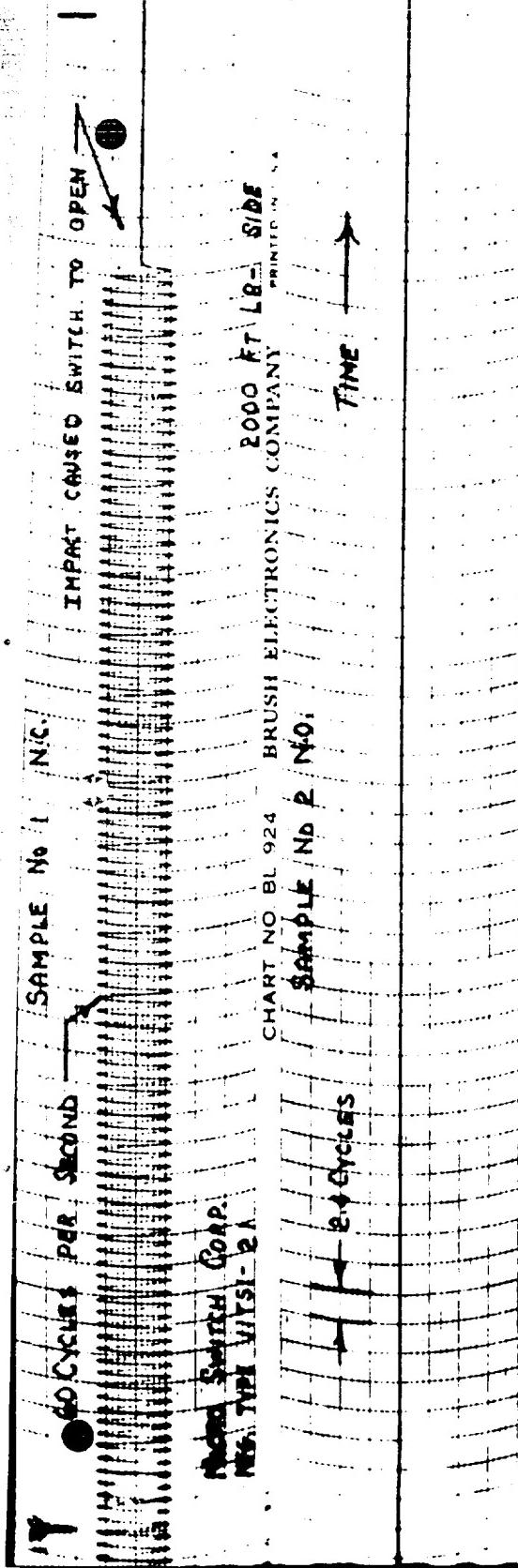
Oscillograms showing contact opening or transfer

TEST No. 2994

ENCLOSURE (5)

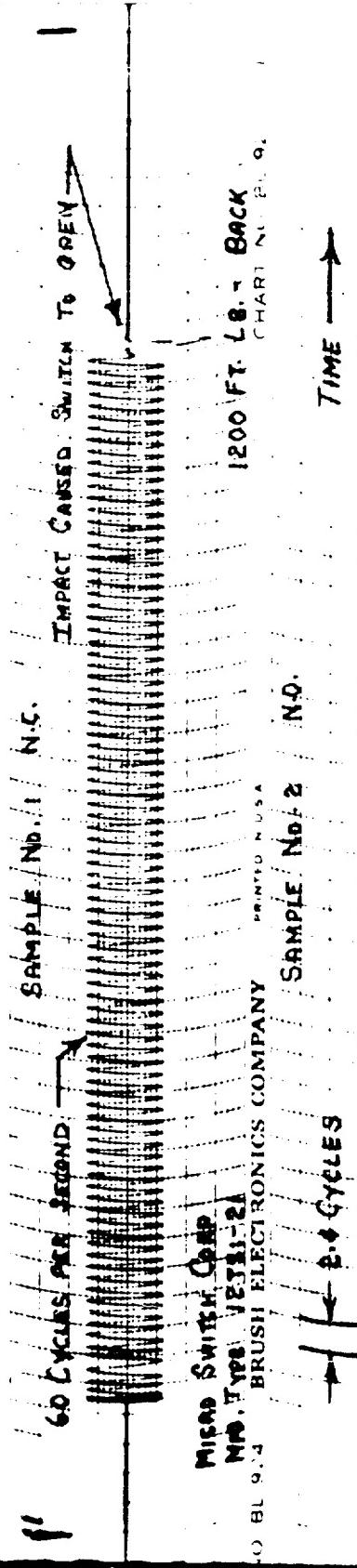
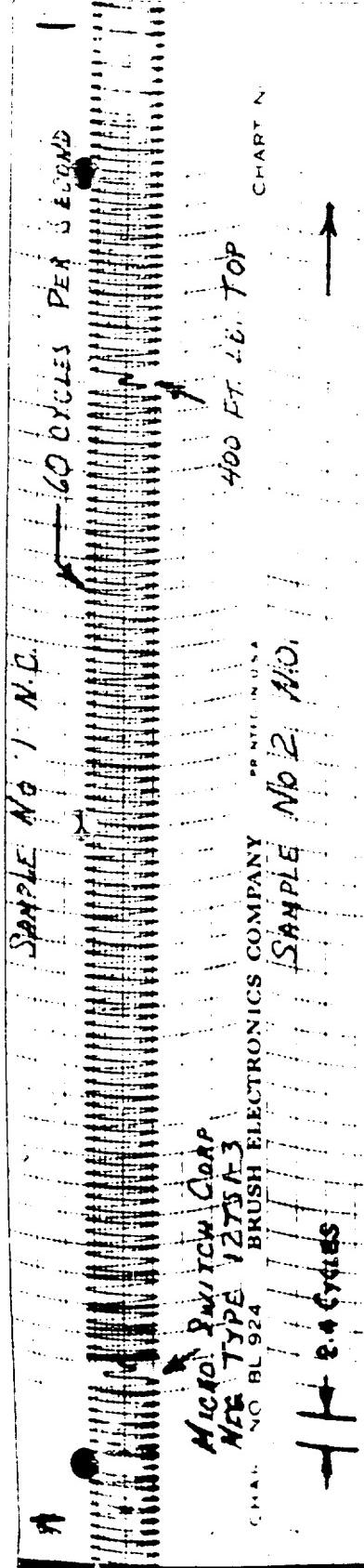
NSM 687-017

SHEET 4



Oscilloscopes showing contact opening or transfer
TEST No 2994
NSM 687-C17

ENCLOSURE (5)
SHEET 5



Oscillograms showing contact opening or transfer
TEST No 2994
NSM 687-017
ENCLOSURE (F)
SHEET 6

SAMPLE NO. 1 N.C.

60 CYCLES PER SECOND

NICRO SWITCH CORP.
MFG. TYPE JITSI-2
BRUSH ELECTRONICS COMPANY

→ 2.4 CYCLES

1200 FT/LB → TYP
CHART NO. BL 924

SAMPLE NO. 2 N.C.

TIME →

SAMPLE NO. 1 N.C. → 60 CYCLES PER SECOND

NICRO SWITCH CORP.
MFG. TYPE JITSI-21
PRINTED IN U.S.A.
MAY 1961 BL 924 BRUSH ELECTRONICS COMPANY

SAMPLE NO. 2 N.O.

→ 2.4 CYCLES

2000 FT/LB → TYP
CHART NO. P 924

TIME →

Oscillograms showing contact opening or transfer

TEST No. 2994

ENCLOSURE (6)
SHEET 7

NSM 687-017

SAMPLE NO. 1 N.C.
(NAT AN. CONTACT)

MICRO SWITCH CORP.
MFG. TYPE 3ETSI-1

ART NO. H. 9. 4 BRUSH ELECTRONICS COMPANY
MANUFACTURED IN U.S.A.

SAMPLE NO. 2 N.O.

→ 2.4 CYCLES.

SAMPLE NO. 1 N.C.
60 CYCLES PER SECOND

MICRO SWITCH CORP.
MFG. TYPE 3ETSI-3

SAMPLE NO. 2 N.O.

→ 2.0 CYCLES

1000 FTS. ← BLOCK
CHAR. NO.

Time →

NSM 687-017

Oscillograms showing contact opening or transfer

TEST NO. 2994

ENCLOSURE 5
SHEET 8

SAMPLE No 1 - N.C.

60 CYCLES PER SECOND



MICRO SWITCH CORP.

MFG. TYPE 32TS1-21

INDIANA ELECTRONICS COMPANY

SAMPLE No 2 - N.O.

60 CYCLES

TIME →

1200 FT. LB. - BACK

IMPACT TEST

SAMPLE No 1 N.C. IMPACT CAUSED SWITCH TO OPEN

60 CYCLES PER SECOND

IMPACT CAUSED SWITCH TO OPEN



MICRO SWITCH CORP.

MFG. TYPE 33TS1-1

CHART NO 121-100

IMPACT TEST

SAMPLE No 2 N.O.

(NOT IN CIRCUIT)

60 CYCLES

TIME →

2000 FT. LB. - TOP

IMPACT TEST

OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

NSM 687-017

TEST No. 2994

ENCLOSURE SHEET 3

60 CYCLES PER SECOND

SAMPLE NO. 1 NO.

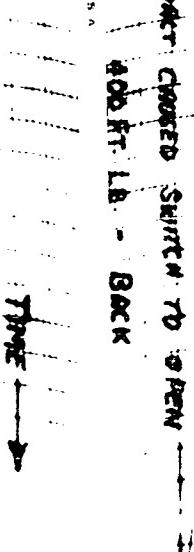
Micad Spring On Contact

MEAS. TIME 237.3

CHART NO. BL 92 BRUSH ELECTRONICS COMPANY

PRINTED IN U.S.A.

2000 FT. LBS. BACK
ADJUST. LB. - BACK



SAMPLE NO. 2 NO.

TIME →

2.4 CYCLES

SAMPLE NO. 1 NO.
(Spring NOT IN CIRCUIT)

MICAD Switch Cap
MFG. TYPE 2 ST-1
BRUSH ELECTRONICS COMPANY

PRINTED IN U.S.A.

2000 FT. LBS. BACK
CHART NO. BL 92
HKL

TIME →

SAMPLE NO. 2 NO.

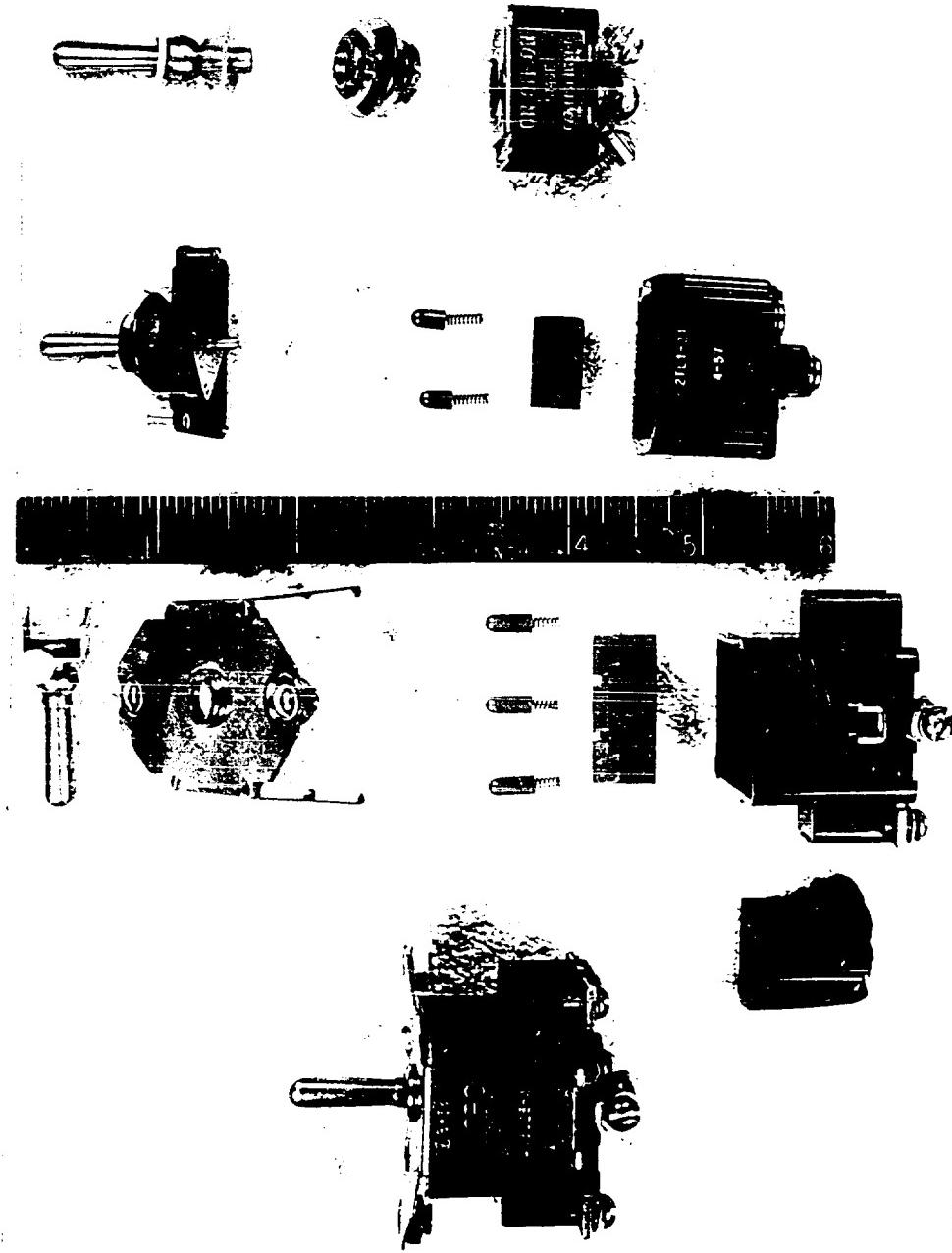
2.4 CYCLES

OSCILLOGRAMS SHOWING CONTACT OPENING OR TRANSFER

SM 687-017

TEST No. 2994

ENCLOSURE
1



00-25-90 - 314
TYPICAL EXAMPLES OF IMAGE MICRO SWITCH CORPORATION TOGGLE SWITCHES AS A RESULT OF HIGH IMPACT SHOCK TEST

LITS1-1

NSM687-017

21L1-2
TEST NO. 2994

33TS1-21
33TS1-1

ENCLOSURE (6)

Report of high impact shock test on toggle switches, mounted on a steel plate, as shown in figure
60 of reference (d) -

Manufacturer's Code	Sample No.	Test Po- sition	Direction of Impact	Impact (Foot- Pounds)	Remarks
ITL1-1	1	E. C.	Back	400	Switch opened under impact
		N. C.	Back	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	Destruction of contact bounce
		N. C.	Top	1200	Destruction of contact bounce
		N. C.	Top	2000	Destruction of contact bounce
	2	E. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Switch opened under impact
		N. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	No damage or indication of contact bounce
		N. C.	Top	2000	No damage or indication of contact bounce
ITL1-3	1	N. C.	Back	400	Destruction of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
	2	N. C.	Back	400	No damage or indication of contact bounce
		N. C.	Back	1200	No damage or indication of contact bounce
		N. C.	Top	2000	No damage or indication of contact bounce
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Side	1200	No damage or indication of contact bounce
		N. C.	Side	2000	No damage or indication of contact bounce

Enclosure (7)

Model Number	Switch Type	Sample No.	Test Po- sition	Direction of Impact	Impact (Spec- tometer pounds)	Insights
ITL1-21	N. C.	1	N. C.	Back	400	Indication of contact bounce
			N. C.	Back	1200	Switch opened under impact
			N. C.	Back	2000	Switch opened under impact
			N. C.	Top	400	No damage or indication of contact bounce
			N. C.	Top	1200	Indication of contact bounce
		2	N. C.	Top	2000	Indication of contact bounce
			N. C.	Side	400	No damage or indication of contact bounce
			N. C.	Side	1200	Indication of contact bounce
			N. C.	Side	2000	Switch opened under impact
			N. O.	Back	400	No damage or indication of contact bounce
ITL1-1	N. C.	1	N. O.	Back	1200	No damage or indication of contact bounce
			N. O.	Back	2000	No damage or indication of contact bounce
			N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
		2	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
			N. O.	Side	2000	No damage or indication of contact bounce
			N. C.	Back	400	Indication of contact bounce
			N. C.	Back	1200	Switch opened under impact
ITL1-1	N. O.	1	N. C.	Back	400	Switch opened under impact
			N. C.	Back	1200	Indication of contact bounce
			N. C.	Top	400	Indication of contact bounce
			N. C.	Top	1200	Indication of contact bounce
			N. C.	Top	2000	Indication of contact bounce
		2	N. O.	Side	400	Indication of contact bounce
			N. O.	Side	1200	Indication of contact bounce - Indication after test indicated mounting bracket had distorted slightly.
			N. O.	Side	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
ITL1-2	N. O.	1	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
		2	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
ITL1-3	N. O.	1	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
		2	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
ITL1-4	N. O.	1	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce
		2	N. O.	Top	400	No damage or indication of contact bounce
			N. O.	Top	1200	No damage or indication of contact bounce
			N. O.	Top	2000	No damage or indication of contact bounce
			N. O.	Side	400	No damage or indication of contact bounce
			N. O.	Side	1200	No damage or indication of contact bounce

Enclosure (7)
Sheet 2

Manufacturer's Switch Type	Sample No.	Test Po- sition	Direction of Impact	Impact (Foot- Pounds)	Remarks
27U1-3	1	N. C.	Back	400	No damage or indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce.
		N. C.	Back	2000	Indication of contact bounce. Locking nut came loose from shaft threads permitting switch to become disengaged from shock plate. Reassembled to test plate. Test continued.
		N. C.	Top	400	No damage or indication of contact bounce.
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce. Examination indicated distortion of the mounting shaft threads.
27U1-1	2	N. O.	Back	400	No damage or indication of contact bounce.
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. C.	Top	2000	No damage or indication of contact bounce. Two of the rivets securing the mounting plate to the switch body loosened and fell out.
		N. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	Interior of switch fell out, after remaining two rivets broke.
27U1-21	1	N. C.	Back	400	Indication of contact bounce. Switch mounting plate loosened from switch body.
		N. C.	Back	1200	Switch became disengaged. Test discontinued.
		N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	Switch became disengaged. Test discontinued. Switch housing fractured.
11781-1	1	N. C.	Back	400	Switch opened under inspect. Sample appears to be loose on mounting shaft.
		N. C.	Back	1200	Switch became disengaged. Test discontinued.
11781-1	2	N. O.	Back	400	Switch mounting shaft appears to be loose at body entrance.
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	Switch became disengaged. Test discontinued

Manufacturer	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Damage
LITSI-3	1	H. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		M. C.	Back	2000	Indication of contact bounce
		H. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		M. C.	Top	2000	Indication of contact bounce
		H. C.	Side	400	Indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		M. C.	Side	2000	Indication of contact bounce
		H. O.	Back	400	No damage or indication of contact bounce
LITSI-3	2	N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Back	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		H. O.	Top	2000	No damage or indication of contact bounce
		H. O.	Side	400	No damage or indication of contact bounce
		N. O.	Side	1200	No damage or indication of contact bounce
		N. O.	Side	2000	No damage or indication of contact bounce
		H. C.	Back	400	Indication of contact bounce
		H. C.	Back	1200	Indication of contact bounce
LITSI-21	1	H. C.	Back	400	Switch opened under impact
		H. C.	Back	2000	No damage or indication of contact bounce
		H. C.	Top	400	Switch opened under impact. When checked, switch could not
		H. C.	Top	1200	be operated and was removed from the plate. Switch could then
		M. C.	Side	400	be operated and was subjected to 100 impacts.
		M. C.	Side	1200	No damage or indication of contact bounce
		M. C.	Side	2000	No damage or indication of contact bounce
		H. O.	Back	400	No damage or indication of contact bounce
		H. O.	Back	1200	No damage or indication of contact bounce
		H. O.	Top	400	No damage or indication of contact bounce
LITSI-21	2	H. O.	Top	1200	No damage or indication of contact bounce
		H. O.	Top	2000	No damage or indication of contact bounce
		H. O.	Side	400	No damage or indication of contact bounce
		H. O.	Side	1200	No damage or indication of contact bounce
				2000	No damage or indication of contact bounce

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Manufacturer's Switch Type	Sample No.	Test Po- sitions	Direction of Impact	Impact (Foot- Pounds)	Remarks
LTSI-1	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact
		M. C.	Back	2000	Switch opened under impact
		N. C.	Top	400	Indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		M. C.	Side	400	Indication of contact bounce
		M. C.	Side	1200	Indication of contact bounce
		M. C.	Side	2000	Switch opened under impact
		M. O.	Back	400	No damage or indication of contact bounce
LTSI-1	2	M. O.	Back	1200	No damage or indication of contact bounce
		M. O.	Back	2000	No damage or indication of contact bounce
		M. O.	Side	400	No damage or indication of contact bounce
		M. O.	Side	1200	No damage or indication of contact bounce
		M. O.	Side	2000	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce
		N. O.	Top	1200	No damage or indication of contact bounce
		N. O.	Top	2000	No damage or indication of contact bounce - Examination after completion of test indicated shaft had loosened on switch body on both samples.
		N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
LTSI-3	1	N. C.	Back	2000	Indication of contact bounce - The shaft was found to be slightly loose on the switch body.
		M. C.	Top	400	Indication of contact bounce
		M. C.	Top	1200	Indication of contact bounce
		M. C.	Side	400	Indication of contact bounce
		M. C.	Side	1200	Indication of contact bounce
		M. C.	Side	2000	Indication of contact bounce
		N. O.	Back	400	No damage or indication of contact bounce
		N. O.	Back	1200	No damage or indication of contact bounce
		N. O.	Top	400	No damage or indication of contact bounce - The shaft was found to be slightly loose on the switch body.
		N. O.	Top	1200	No damage or indication of contact bounce
LTSI-3	2	N. O.	Top	2000	No damage or indication of contact bounce

Model No.	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
31TSI-3	2	H. O.	Side	400 1200 2000	No damage or indication of contact bounce No damage or indication of contact bounce - Examination after test indicates slight distortion of mounting bracket on both samples.
31TSI-21	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Indication of contact bounce
		N. C.	Back	2000	Indication of contact bounce
		N. C.	Top	400	No damage or indication of contact bounce
		N. C.	Top	1200	Indication of contact bounce
		N. C.	Top	2000	Indication of contact bounce
		N. C.	Side	400	No damage or indication of contact bounce
		N. C.	Side	1200	Indication of contact bounce
		N. C.	Side	2000	Indication of contact bounce
		H. O.	Back	400	No damage or indication of contact bounce
		H. O.	Back	1200	No damage or indication of contact bounce
		H. O.	Back	2000	No damage or indication of contact bounce
		H. O.	Top	400	No damage or indication of contact bounce
		H. O.	Top	1200	No damage or indication of contact bounce
		H. O.	Top	2000	No damage or indication of contact bounce
		H. O.	Side	400	No damage or indication of contact bounce
		H. O.	Side	1200	No damage or indication of contact bounce
		H. O.	Side	2000	No damage or indication of contact bounce - Examination after test indicates slight distortion of mounting bracket on both samples
32TSI-1	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch, when checked for operation after impact, could not be opened - Test discontinued.
32TSI-1	2	H. O.	Back	400	No damage or indication of contact bounce
		H. O.	Back	1200	No damage or indication of contact bounce
		H. O.	Back	2000	Switch momentarily closed during impact and could not be opened - Test discontinued
32TSI-3	1	N. C.	Back	400	Indication of contact bounce
		N. C.	Back	1200	Switch opened under impact. Internal damage detected. Test discontinued

Inclosure (7)
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Model "V"	Curve	Sample No.	Test Position	Direction of Impact	Impact (Foot-Pounds)	Remarks
32T61-3	3	2	H. O.	Back	400	No damage or indication of contact bounce
			H. O.	Back	1200	No damage or indication of contact bounce
			H. O.	Back	2000	No damage or indication of contact bounce
			H. O.	Top	400	No damage or indication of contact bounce
			H. O.	Top	1200	No damage or indication of contact bounce
			H. O.	Top	2000	No damage or indication of contact bounce
			H. O.	Side	400	No damage or indication of contact bounce
			H. O.	Side	1200	No damage or indication of contact bounce
			H. O.	Side	2000	No damage or indication of contact bounce
32T61-21	1		H. C.	Back	400	Indication of contact bounce
			H. C.	Back	1200	Indication of contact bounce
			H. C.	Back	2000	Switch opened under impact
			H. C.	Top	400	No damage or indication of contact bounce
			H. C.	Top	1200	No damage or indication of contact bounce
			H. C.	Top	2000	No damage or indication of contact bounce
			H. C.	Side	400	No damage or indication of contact bounce
			H. C.	Side	1200	No damage or indication of contact bounce
			H. C.	Side	2000	No damage or indication of contact bounce
32T61-21	2		H. C.	Back	400	Indication of contact bounce
			H. C.	Back	1200	No damage or indication of contact bounce
			H. C.	Back	2000	No damage or indication of contact bounce
			H. C.	Top	400	No damage or indication of contact bounce
			H. C.	Top	1200	No damage or indication of contact bounce
			H. C.	Top	2000	No damage or indication of contact bounce
			H. C.	Side	400	No damage or indication of contact bounce
			H. C.	Side	1200	No damage or indication of contact bounce
			H. C.	Side	2000	No damage or indication of contact bounce
32T61-1	1		H. C.	Back	400	Indication of contact bounce
			H. C.	Back	1200	Switch opened under impact
			H. C.	Back	2000	Switch opened under impact
			H. C.	Top	400	Indication of contact bounce
			H. C.	Top	1200	Indication of contact bounce
			H. C.	Top	2000	Switch opened under impact
			H. C.	Side	400	Indication of contact bounce
			H. C.	Side	1200	Indication of contact bounce
			H. C.	Side	2000	Indication of contact bounce. Mounting bracket was distorted and side plate was loose.

Enclosure (7)
Sheet 8

Manufacturer	Sample No.	Test Position	Direction of Impact	Impact (Foot Pounds)	Lessons Learned
33TEL-1	1	N. O.	Back	400	No damage or indication of contact bounce
	2	N. O.	Back	1200	No damage or indication of contact bounce
		S. O.	Back	2000	Switch became disassembled as a result of the impact - Test discontinued
33TEL-3	1	E. C.	Back	400	Switch opened during impact. Lack of continuity in switch - Test discontinued
33TEL-3	2	N. O.	Back	400	Switch lost continuity as a result of impact - Test discontinued
33TEL-21	1	S. C.	Back	400	switch opened under impact
33TEL-21	2	S. C.	Back	1200	Switch became disassembled. Test discontinued
		N. O.	Back	400	No damage or indication of contact bounce
		S. O.	Back	1200	No damage or indication of contact bounce
		S. O.	Back	2000	Switch became disassembled. Test discontinued

NOTES: Test Position - N. C. Indicates normally closed contacts.
 Test Position - N. O. Indicates normally open contacts.

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